Effects of testing methods and conditions on the elastic properties of limestone rock

Al-Shayea, N.A.

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Abstract: This paper presents results of a laboratory experimental program performed on limestone rock samples, using both static and dynamic methods. The objective is to compare elastic properties (elastic modulus and Poisson's ratio) for limestone rock, determined by static and dynamic methods, under different conditions. The static elastic modulus and Poisson's ratio were determined using cylindrical specimens tested under unconfined compression using a strain-controlled loading frame. Minor cycles of unloading-reloading were made at various stress levels. The data were analyzed to evaluate the effect of stress-strain level on the secant and tangent moduli as well as on Poisson's ratio. The values of the tangent modulus and Poisson's ratio during the minor cycles at various stress levels were also obtained. The dynamic elastic modulus and Poisson's ratio were determined for rock specimens using an ultrasonic system equipped with pairs of transmitting and receiving transducers: one P-wave and two polarized S-waves. Measurements were made at different confining pressures. The effects of cyclic loading, unloading, and reloading conditions were investigated. The static and dynamic results obtained for the investigated rock were analyzed and compared. The findings were also compared with similar results available in the literature for limestone rocks. The equivalent confinement to compensate for the cohesion was introduced to have a general form for the initial modulus that can be used even for cohesive materials at unconfined condition. For unconfined condition, the initial modulus is correlated with the unconfined compressive strength.